Symposium: The Science of Global Climate Change

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Computer Modeling of the Global Climate & its Role in the Assessment of Climate Change

Keith W. Dixon

research meteorologist
Geophysical Fluid Dynamics Laboratory (GFDL)
National Oceanic & Atmospheric Administration (NOAA)
US Department of Commerce
Princeton, New Jersey USA
Email: Keith.Dixon *(at)* noaa.gov
Web Page: http://www.gfdl.noaa.gov/~kd

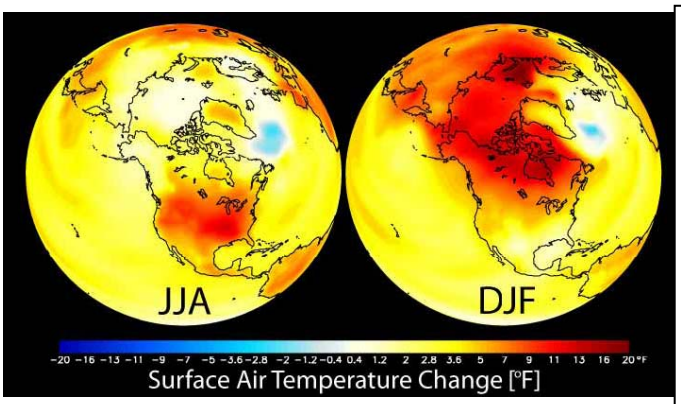
Abstract:

Using state-of-the-art supercomputers as their laboratories, climate modelers employ mathematical models of the planet's global climate system to conduct climate variability and change research. Since the first such models were developed in the 1970s, each successive generation of climate models has become more physically realistic and has yielded more accurate simulations of the contemporary climate. One may consider global climate models to consist of four major physical components (atmosphere, ocean, land, and sea ice), each of which interacts with the others, sometimes in non-linear ways. The next generation of models will likely contain more complex interactive atmospheric chemical transport models, as well as models of oceanic and terrestrial biogeochemical processes to represent carbon and nitrogen cycles.

Focusing on the period 1860 to 2100, this presentation will illustrate how, by incorporating what is known from observations and theory, climate models have been used to deconstruct and explore the relative effects of different anthropogenic and natural factors involved in driving climate change and determining feedback mechanisms – the detection and attribution process. It is this synergy of theory, modeling and observations that led the Intergovernmental Panel on Climate Change (IPCC) to include the following statements in their recently released Summary for Policymakers (www.ipcc.ch/SPM2feb07.pdf):

- "*Warming of the climate system is unequivocal*" .."Eleven of the last twelve years (1995-2006) rank among the 12 warmest years in the instrumental record of global surface temperature (since 1850)."
- "Most of the observed increase in globally averaged temperatures since the mid-20th century is *very likely [>90% probability]* due to the observed increase in anthropogenic greenhouse gas concentrations."
- *"Projected warming in the 21st century shows scenario-independent geographical patterns similar to those observed over the past several decades. Warming is expected to be greatest over land and at most high northern latitudes, and least over the Southern Ocean and parts of the North Atlantic Ocean."*
- *"Increases in the amount of precipitation are very likely in high latitudes, while decreases are likely in most subtropical land regions...continuing observed patterns in trends."*
- *"Sea ice is projected to shrink in both the Arctic and Antarctic …In some projections, Arctic late-summer sea ice disappears almost entirely by the latter part of the 21st century"*

Climate change features will be illustrated in part by results drawn from NOAA/GFDL climate model studies (see http://www.gfdl.noaa.gov/research/climate/highlights). Sources of uncertainty will be discussed.



caption: GFDL CM2.1 model-simulated change in seasonal mean surface air temperature from the late 20th century (1971-2000 average) to the middle 21st century (2051-2060). The left panel shows changes for June July August (JJA) seasonal averages, and the right panel shows changes for December January February (DJF). The simulated surface air temperature changes are in response to increasing greenhouse gases and aerosols based on a "middle of the road" estimate of future emissions known as IPCC SRES A1B. Warming is projected to be larger over continents than oceans, and is largest at high latitudes of the Northern Hemisphere during Northern Hemisphere winter.